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Comparing Injecting and Non-Injecting Illicit Opioid Users in a Multisite Canadian Sample (OPICAN Cohort)

Benedikt Fischer^{a,b} Patrik Manzoni^a Jürgen Rehm^{a,b}

^aCentre for Addiction and Mental Health, ^bDepartment of Public Health Sciences, University of Toronto, Toronto, Canada

Key Words

Opioid use · Drug culture · Drug market · Route of administration

Abstract

Illicit opioid use in Canada and elsewhere increasingly involves a variety of opioids and non-injection routes of administration. Injection and non-injection opioid users tend to differ in various key characteristics. From a public health perspective, non-injection routes of opioid use tend to be less harmful due to lesser morbidity and mortality risks. Our study compared current injectors (80%) and non-injectors (20%) in a multi-site sample of regular illicit opioid users from across Canada ('OPICAN' study). In bivariate analysis, injectors and non-injectors differed by prevalence in social and health characteristics as well as drug use. Logistic regression analysis identified city, drug use, housing status and mental health problems as independent predictors of injection status. Further analysis revealed that the majority of current non-injectors had an injection history. Our results reinforce the need to explore potential interventions aimed at preventing the transition from non-injectors to injecting, or facilitating the transition of injectors to non-injecting, as initiated in several other contexts.

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Introduction

In recent years, the phenomenon of illicit opioid use has become increasingly diversified in Western societies, mainly linked to two developments. First, in several countries illicit opioid use commonly involves a rather heterogeneous range of opioid drugs: hydromorphone, oxycontin, morphine, i.e. typically analgesics diverted from medical sources among which, depending on the context, heroin may play only a small or no role at all [1–3]. Second, trends from various settings suggest that an increasing proportion of illicit opioid users administer their drugs by non-injection routes. For example, smoking of heroin has become predominant in many Western European drug cultures and sniffing is the more commonly reported non-injection form of heroin use in the US [4–12]. Recent research has shown that illicit opioid use in Canada includes a large variety of different opioid drugs, with local variance in terms of heroin use [13].

Evidence from other studies suggests a variety of differences in key characteristics between injection and non-injection opioid users, with the former typically featuring higher levels of risk behaviors or harm outcomes. Socio-demographically, various samples have demonstrated that non-injection heroin users are more likely to be younger, female and socially stable than injectors [6, 7, 12, 14–16]. Several studies have examined the transition

dynamics between different routes of administration of heroin and related risk factors [10, 12, 17, 18]. For example, Griffiths et al. [12] reported that 39% of their sample of in- and out-of-treatment heroin users in London had changed route of administration at least once. There is also evidence that the majority of heroin users start off with a non-injection way of administration [10, 17], though heroin sniffing can also be a long-term route of administration [10]. Griffiths et al. [12] reported that heroin users have clear preferences for their route of administration. Variability in method of administration has been shown to depend on a range of circumstances, including (sub-) cultural influences [19], the types of heroin available on the market [18, 20] and the socio-ecological context [8, 21, 22].

Drug use career patterns can vary depending on route of opioid administration. Heroin injectors tend to start drug use at an earlier age than non-injectors [12, 23], who typically indicate shorter duration of regular drug use [12, 14–16, 24]. Injectors often indicate more intense patterns of drug use, as expressed through higher levels of dependence or higher frequency of use [14, 24–27], and consequently higher drug expenditures [28]. In terms of poly-drug use, heroin non-injectors have been described to be less likely to use cocaine or other stimulants [8, 14, 15], although select studies have found a strong relationship between heroin smoking and oral crack use [29]. Injectors also typically report greater lifetime involvement in alcohol and other non-opioid drug use [23, 28, 30].

Heroin injectors overall appear to be in poorer physical and mental health than non-injectors. Studies from several countries evidence that non-injection users are less likely to have been infected with HIV, Hepatitis B (HBV) or Hepatitis C (HCV) [7, 15, 16, 23, 28, 31]. Non-injection users, however, are still at risk for transmission of HIV, HBV or HCV, especially those involved in sex work [32]. Furthermore, risk behaviors related to non-injection forms of substance use (e.g., the sharing of cocaine or crack use paraphernalia) have been tentatively associated with possible HCV transmission [33–35]. As for mental health, Andersen et al. [23] found a higher prevalence of psychiatric disorders in the injector group compared to non-injectors in a prisoner sample. Dinwiddie et al. [30] reported higher rates of antisocial personality disorder – but no differences for mood disorders – for injectors in comparison to non-injectors in a sample of street drug users.

Existing data on treatment utilization, although sparse, suggest that injectors tend to have increased exposure and

higher involvement in treatment compared to non-injectors [15]. For instance, Griffiths et al. [12] found that 75% of their heroin injector sample and only 37% of current non-injectors had been in contact with drug treatment programs. In a sample of opiate-dependent detoxification inpatients, Andersen et al. [23] reported that injectors were more likely to enroll in treatment programs after completion. Finally, evidence on drug users' experiences with the criminal justice system suggests that injectors commit more offences, presumably due to a greater need for acquisitive crime to cover the expense of more extensive drug use. Stohler et al. [15] reported that injectors had more criminal charges, were more likely to have been charged with drug-related offences, and had spent longer periods of time in custody.

Relatively little attention has been paid to the phenomenon of non-injection opioid use in Canada, where the primary focus is typically given to the estimated population of 90,000–125,000 injection drug users [36, 37]. A cohort study of illicit opioid and other drug users in five Canadian cities ('OPICAN') included both injectors and non-injectors, and provided a good opportunity for empirical comparison [13]. On this basis, the main objective of this paper is to explore (a) key differences between current injection and non-injection opioid users in the OPICAN cohort, and (b) potential predictors of current injection status.

Methods

Sample

The present analyses were based on baseline data from the OPICAN cohort study [13], a multisite study of illicit opioid users from five Canadian cities, namely Edmonton, Montreal, Quebec City, Toronto and Vancouver. Eligibility for participation in the OPICAN cohort was based on the following criteria: (1) using illicit opioids for a minimum of 1 year on the majority of days in the week, (2) not having been in a drug treatment program in the previous 6 months and (3) being at least 18 years old. Participants were recruited using community/outreach-based snowball techniques such as posters, flyers, community liaisons and word-of-mouth. After eligibility screening, participants were assessed by a standardized multicomponent protocol (see below) uniformly applied across the study sites [38]. Participants provided informed consent and were paid a fee. Baseline data were collected between March and December 2002, resulting in a total sample of 677 eligible participants. The study was approved by the local Research Ethics Boards in the study sites.

Variables

Participants' injection status was the main variable of analysis, based on the ('yes' or 'no') answer to the following two questions: 'In the last 30 days, did you inject any drug?', and 'Have you ever

used needles to inject any drug?' The first question allowed for the differentiation between 'current injectors' and 'current non-injectors'. Among the 'current non-injectors', those who had answered 'yes' to the second question were categorized as 'past injectors' (i.e., individuals who did not inject in the last 30 days but still had a history of injecting drugs), whereas the rest were categorized as 'lifetime non-injectors' (i.e., individuals who never injected drugs in their life).

All variables included in the bivariate and the subsequent multivariate analysis were selected on the basis of evidence from the literature, and based on self-report data from the interviewer-administered study questionnaire, except for HIV and HCV status, which were determined by way of salivary antibody testing [13]. Specific types of drugs included in the analysis included (all for use in last 30 days): heroin, cocaine, crack, alcohol, Valium (benzodiazepine), Tylenol (T) 3 or 4 (codeine) and Dilaudid (hydromorphone). Evidence from previous analyses had demonstrated the association between these drugs and injection status [39]. Drug use frequency was measured by the number of days each drug had been used in the last 30 days. Health status was based on participants' self-assessment on a five-point-scale (excellent, very good, good, fair and poor); for analysis purposes, the first 3 and the last 2 values were collapsed. Both physical health and mental health indicators were based on self-report responses to questions asking participants whether they had any physical or mental health problems. Illegal income referred to income generated by property crime (or other crime), drug dealing, or sex work/hustling in the last 30 days. Participants' housing status was categorized into one of three possible groups, namely 'permanent' (regular house, apartment, room), 'transitional' (rooming house, shelter, temporary room or space) or 'street' (homeless, no fixed address). All other variables were based on standard self-report data.

Analysis

Due to missing values in the variables examined, the analysis sample was reduced to 624 cases. The analyses consisted of two parts. First, we assessed bivariate associations between current injection status and the above-described variables. The significance of bivariate associations was assessed by χ^2 statistics for categorical variables and t test for continuous variables. The level of significance was set at $p < 0.05$. For categorical variable differences between injecting status, groups were considered significant if the adjusted standardized residual was greater than 2.0 [40]. In the second part, current injection drug use status ('yes' vs. 'no') was statistically predicted by logistic regression, including only – in line with the conceptual theory behind logistic regression – potential predictors of this dependent variable suggested by previous research. These included: age, gender, city, housing status, health rating, physical and mental health problems, illegal income, and use of select drugs. We also tested possible interactions between city and specific variables in order to examine whether the influence of these variables on injection status depended on site. The inclusion of interaction terms was limited to variables that were marginally significant (at the level of $p < 0.10$) in the regression model. We did not test for the impact of interactions between drug types and site on injection status, since previous analysis had demonstrated the existence of highly distinct drug cultures and drug use patterns found in each of the study sites [13]. Given that regression analysis simulates the relationship of variables by holding other factors constant, such interaction analysis would have been counterintuitive,

Table 1. Injection status (current injection vs. current non-injection) of OPICAN participants, by site and total)

	Current non-injectors (n = 127)	Current injectors (n = 497)	Total (n = 624) %	χ^2 square (d.f.)
Edmonton	12.2	87.8	100.0	58.60 (4)**
Montreal	19.9	80.1	100.0	
Quebec City	11.3*	88.8*	100.0	
Toronto	43.0*	57.0*	100.0	
Vancouver	11.6*	88.4*	100.0	
Total	20.4	79.6	100.0	

Unless otherwise stated, results are percentages.

* $p < 0.05$, ** $p < 0.001$, for adjusted standardized residuals > 2.0 .

generating ambiguous results. None of the tested interaction terms reached a level of significance, thus the effects of all variables examined in our analysis were independent of study site.

Results

Of the present study sample of untreated illicit opioid users, 497 (79.6%) reported that they had injected any drug in the 30 days before the assessment and were hence classified as current injectors, while 127 (20.4%) did not report such injecting behavior and were classified as current non-injectors.

Differences between Current Injectors and Current Non-Injectors

Current injectors differed from current non-injectors on a number of the characteristics examined in the bivariate analysis. In terms of socio-demographics, there were significant variations between the study sites regarding participants' current injection status (table 1). While in the total sample 4 out of 5 participants were current injectors, a significantly lower proportion of current injectors (57%) were found in Toronto, whereas in Vancouver (88%) and Quebec City (89%) the proportion of current injectors was significantly higher. Housing status was also significantly associated with current injection status (table 2). In particular, a higher proportion of current injectors (18%) were living on the street compared to non-injectors (5%). No significant difference, however, was found for associations with age and gender.

Table 2. Bivariate associations between selected variables and injection status (current injection vs. current non-injection)

Variables	Current non-injectors (n = 127)	Current injectors (n = 497)	Total (n = 624)	χ^2 square/t test (d.f.)
<i>Demographic</i>				
Gender, % female	29.1%	33.4%	32.5%	0.84 (1)
Age, years, mean \pm SD)	36.0 \pm 9.8	34.6 \pm 9.2	34.9 \pm 9.4	1.39 (187.7)
Housing				14.09 (2)**
Permanent	52.8%	43.7%	45.5%	
Transitional	42.5%	38.2%	39.1%	
Street	4.7%*	18.1%*	15.4%	
<i>Health</i>				
Health rating (self)				4.71 (1)*
Poor or fair	41.7%*	52.5%*	49.7%	
Good or better	58.3%*	47.5%*	50.3%	
Physical health problem (self-reported)	69.3%	71.0%	70.7%	0.15 (1)
Mental health problem (self-reported)	42.5%*	27.8%*	30.8%	10.34 (1)**
HIV-positive ^a	10.1%	16.9%	15.5%	3.06 (1)
HCV-positive ^b	31.1%	59.0%	52.9%	25.24 (1)***
Overdose (last 6 months)	16.5%	17.7%	17.5%	0.01 (1)
In treatment (last 12 months)	27.6%	26.4%	26.6%	0.08 (1)
Interested in MMT	22.8%*	34.2%*	31.9%	6.02 (1)*
<i>Crime and Criminal Justice</i>				
Illegal income	42.5%	56.3%	53.5%	7.76 (1)**
Arrested (last 12 months)	41.7%	52.1%	50.0%	4.36 (1)*
Detention (last 12 months)	37.8%	43.3%	42.1%	1.24 (1)
<i>Drug use (days last month)</i>				
Heroin use	9.5 \pm 12.6	16.2 \pm 13.1	14.9 \pm 13.2	-5.33 (201.2)***
Cocaine use	1.9 \pm 4.9	7.7 \pm 10.8	6.6 \pm 10.2	-8.95 (455.1)***
Crack use	8.0 \pm 11.3	9.7 \pm 12.4	9.4 \pm 12.2	-1.53 (211.2)
Dilaudid use	2.3 \pm 6.3	4.7 \pm 9.3	4.2 \pm 8.8	-3.46 (281.5)**
T3, T4 use	8.6 \pm 11.7	3.5 \pm 8.3	4.5 \pm 9.3	4.70 (159.8)***
Valium use	5.9 \pm 10.2	3.3 \pm 7.6	3.8 \pm 8.2	2.69 (163.4)**
Alcohol use	8.2 \pm 10.0	6.6 \pm 9.8	6.9 \pm 9.9	1.60 (622)
* p < 0.05, ** p < 0.01, *** p < 0.001, for adjusted standardized residuals >2.0.				
^a HIV-positive: n = 517 (i.e., 109 current non-injectors, 408 current injectors); based on salivary antibody test.				
^b HCV-positive: n = 476 (i.e., 103 current non-injectors, 373 current injectors); based on salivary antibody test.				
MMT = Methadone maintenance treatment.				

In terms of health characteristics, current injectors were more likely to self-report poor or fair overall health (53%) than non-injectors (42%). They also indicated a much higher level of HCV infection (59 vs. 31%). Conversely, non-injectors were more likely to report mental health problems than injectors (43 vs. 28%). No differences between the two groups were found for reports of physical health problems, the prevalence of recent over-

dose experiences and HIV status. There were no differences between injectors and non-injectors with respect to treatment in the past year; however, injectors expressed more interest in enrolling in methadone maintenance treatment (MMT) than non-injectors (34 vs. 23%).

Furthermore, current injectors were more likely to have generated income from criminal activities (56 vs. 43%) and to have been arrested in the past year (34 vs.

Table 3. HIV status, HCV status and overdose by never injectors, past injectors and current injectors

	Lifetime non-injectors (n = 41)		Past injectors (n = 86)		Current injectors (n = 497)		Total (n = 624)		χ^2 square (d.f.)
	%	n	%	n	%	n	%	n	
HIV-positive ^a	10.5	4	9.9	7	16.9	69	15.5	80	3.07 (2)
HCV-positive ^b	5.1*	2	46.9	30	59.0*	220	52.9	252	42.19 (2)**
Overdose (last 6 months)	12.2	5	12.2	16	18.6	88	17.7	109	0.89 (2)

* $p < 0.05$, ** $p < 0.001$, for adjusted standardized residuals > 2.0 .

^a HIV-positive: $n = 517$ (38 lifetime non-injectors, 71 past injectors, 408 current injectors).

^b HCV-positive: $n = 476$ (39 lifetime non-injectors, 64 past injectors, 373 current injectors).

23%), yet there was no significant difference between injectors and non-injectors in their exposure to detention in the last 12 months (43 vs. 38%).

Differences were also found with regards to drug use. On the one hand, current injectors reported significantly higher numbers of average days of cocaine, heroin and Dilaudid use, while the use of T3/T4 tablets as well as Valium was significantly more common among non-injectors. No differences were found with regards to crack and alcohol use.

Data indicating that current non-injectors featured relatively high rates of HIV and HCV as well as overdose experiences led us to a more differentiated examination of this group, in which they were divided into past injectors and lifetime non-injectors for these variables. Table 3 shows the results of this three-group comparison. Looking at HCV status, a significant difference between lifetime non-injectors and current injectors (5 vs. 59%) emerged. Past injectors also had a relatively high HCV rate of 47% and thus featured a similar HCV infection rate to that of current injectors. With regards to HIV status, no significant difference was found between any of the three groups, although current injectors had a somewhat higher rate (17%) than the other two groups (about 10% each).

Likewise, there was no difference between the three groups in terms of having experienced an overdose in the last 6 months. Here again, current injectors were at slightly higher risk (19%) than the other two groups (about 12% each).

Predictors of Current Injecting Status

In the second part of our analyses, we estimated a logistic regression model in order to assess the independent influence of specific variables on current injection drug

use status (table 4). In contrast to the bivariate tests, we only included variables that we perceived as potential predictors of drug injection. The emerging odds ratios (ORs) were interpreted as the relative risk of having injected a drug in the month preceding the assessment.

For demographic variables, housing status and study site emerged as significant predictors. Individuals who were living on the street were about 3.5 times more likely to be current injectors than those living in permanent housing. Those living in transitional housing (e.g., boarding house, hostel) were not significantly more at risk of current injection compared to the latter group. Participants living in Edmonton were almost 5 times more likely to be current drug injectors than those living in Vancouver. Montreal and Toronto users each had about half the risk of reporting current injection compared with Vancouver study participants; however, we cannot exclude the possibility that these differences were due to chance, as they did not produce statistical significance.

Among the health-related factors, only mental health problems were significantly associated with users' injection status. Those reporting such problems were at about 40% lesser risk of current injecting.

In terms of drug use, the frequency of cocaine, heroin and Dilaudid use was associated with higher risk of current drug injection. Specifically, for every 10 days of cocaine use (per month) the likelihood of injecting almost tripled (184% increase). In a similar direction, the odds of injecting increased by 79% for every 10 days of heroin use and by 63% for every 10 days of Dilaudid use¹. Participants also reporting the use of crack or Valium did not feature an increased risk of injecting drugs.

¹ The odds ratio of 10 days' use was calculated by raising the respective OR to the 10th power; for example, for heroin $1.79 = 1.0610$.

Table 4. Logistic regression model of 'current injector' status

	OR	95% CI		p
		lower	upper	
Gender, male	0.85	0.50	1.43	0.532
Age	1.02	0.99	1.05	0.316
City (Vancouver)	***			0.000
Edmonton	4.88**	1.72	13.87	0.003
Montreal	0.46	0.19	1.07	0.072
Quebec-City	1.46	0.43	4.96	0.545
Toronto	0.55	0.25	1.21	0.137
Housing (permanent)	*			0.041
Transitional	1.24	0.76	2.02	0.396
Street	3.47*	1.31	9.14	0.012
Health rating (poor or fair)				
Good or better	0.63	0.39	1.02	0.062
Physical health problem ^a	1.67	0.94	2.94	0.079
Mental health problem ^a	0.60*	0.36	0.99	0.046
Valium, frequency of use ^b	1.00	0.97	1.03	0.915
T3/T4s, frequency of use ^b	0.95***	0.93	0.98	0.000
Cocaine, frequency of use ^b	1.11***	1.06	1.16	0.000
Crack, frequency of use ^b	0.99	0.96	1.02	0.433
Heroin, frequency of use ^b	1.06***	1.03	1.08	0.000
Dilaudid, frequency of use ^b	1.05*	1.01	1.10	0.010
Illegal income, yes	1.18	0.71	1.97	0.518

The reference group is specified in brackets.

^a Self-reported problem in the last 12 months.

^b Number of days used in the last month.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ($n = 624$)

For variables with more than two categories (e.g. city), level of significance for all categories combined is indicated in the first row.

Finally, users who generated income from illegal sources (property crime, drug dealing or sex work) were significantly more likely to be current drug injectors than those not involved in such activities.

Discussion

Our analyses offered an examination of differences between current injectors and non-injectors in the OPICAN cohort, as well as an exploration of possible predictors of injection status in this population. First, we observed that a sizable minority – about 1 in 5 participants – in the OPICAN cohort were current non-injectors. So far, the predominant attention has been on injecting drug users in the Canadian context, with little focus on non-injectors. Our data documents that – similar to other jurisdictions [9, 17, 19, 41] – a non-injection population of street drug users exists in Canadian cities that warrants distinct consideration. Notably, the proportions of non-injectors

in the study cohort varied considerably between cities, with, for example, the rate of non-injectors being about 4 times higher in Toronto than in Vancouver or Quebec City. Other Canadian studies of illicit drug user populations appear to corroborate these local patterns or differences, although the possibility for systematic comparison is limited due to the local nature of these studies as well as the distinct study criteria and foci [42–45]. Given that site also emerged as a predictor of injection status in the logistic regression, it is reasonable to assume that socio-environmental factors, including drug cultures, drug markets, health or social services and enforcement, may play a substantial role in influencing injection status. Our data limitations regrettably do not allow for further causal analyses of these circumstances, yet this should be a topic of future research.

Evidently, the population of current injectors from this cohort is characterized by a variety of factors that render them a population at elevated levels of risks related to their drug use compared to the current non-injec-

tion group. Compared to current non-injectors, current injectors exhibited a higher level of HCV infection, self-reported worse health status, were more likely to be inadequately housed, more likely to generate illegal income and to have been arrested in the past year. These social and health determinants have been identified in previous studies as major predictors of preeminent harms associated with street drug use and thus reinforce the notion that the current injector group in our study is of great public health concern [46–49].

Clearly, there were some indicators where differences between the two main comparison groups did not materialize, contrary to what could have been expected from the literature. For example, we found no significant differences in average age, recent overdose experiences or HIV status between the two groups (although the latter was probably due to small numbers). A deeper investigation triggered by these observations, however, revealed that in fact our observed current non-injection group consisted to a large extent of past injectors, i.e., users who had been injecting drugs in the past but were not doing so currently, versus a smaller number of individuals who reported that they had never injected drugs. While the never-injection group also demonstrated risk characteristics for HIV or HCV infection or overdose, this analysis highlights the possible phenomenon of switching routes of administration in our study sample, as it has also been shown in other studies [5, 8, 9]. In effect, a rather sizable proportion of our study sample (14%, $n = 86$) had shifted from injection to non-injection drug use practices at some point in their career, transitioning from a risky to a somewhat less risky form of drug use. Additional analyses showed that the sub-group of past injectors was significantly older than the group who had never injected (data not shown), which may underscore the possibility of a ‘career’ pattern with older drug users ‘maturing out’ of their injection practices [12, 50, 51]. Our data did not allow for further analyses on the question of overall dynamics or causes behind this transition phenomenon; however, future studies ought to focus on this important question.

Our logistic regression model of current injection status documented the primary influence of site or environment (as discussed above) as well as the use of several specific substances in determining current injection practices in our sample. Frequency of heroin, cocaine and Dilaudid was positively associated with active injection status. This relationship can be interpreted in several ways. First, users for whom the abovementioned substances were the primary drugs of choice, the preferred

route of administration was through injection in order to achieve the desired effects. Second, given that the local study sites featured distinct drug markets, injection status indirectly may have been a function of drug availability on local drug markets and their typical routes of administration (again pointing to the role of site ecology). Third, route of administration has also been associated with economic dynamics, namely that drug injecting can be the result of a desire for the most ‘cost-effective’ use of drugs, i.e., to reach maximum effect under the conditions of limited means (e.g., high drug prices or limited resources for acquisition) [17, 52]. On the other hand, we observed that for a couple of substance types (e.g., Valium, T3/T4), use was associated with current non-injecting. These overall associations between type of substance used and route of administration mirror the findings of a latent class analysis with the OPICAN baseline sample, from which distinct ‘injector’ and ‘non-injector’ groups emerged as defining clusters [39].

Our analysis offers some key implications for interventions and policy. First, given the elevated risk and harm profile of the current injector group, the main focus of active interventions – be it treatment or more pragmatic harm reduction efforts – must be targeted toward this population on both an individual and a public health level. Clearly, needle exchange programs are a core element of secondary prevention efforts for injectors and have been shown effective in reducing injection-related risk behaviors [53, 54]. While needle exchange programs exist in all OPICAN study sites and most cities across Canada, their utilization remains limited, and numerous studies have demonstrated that a much broader approach, ranging from housing or income support to supervised injection facilities, is required [55–57]. The feasibility and impact of the latter is currently under exploration in a pilot study in Vancouver and discussed in several other Canadian cities [58]. Given the strong predictive role of heroin and cocaine use, the need for more effective treatment interventions for these substances is evident. Such programs must go beyond the current standard of MMT, which has a limited rate of acceptance among heroin users and in many instances even exacerbates the desire for cocaine use [59–61]. Additionally, our study highlights the need for prevention effort, specifically targeting differences in injection status. A specific understanding – in our case for the Canadian con-text – is required on (a) what measures can effectively be applied to prevent the (small) group of never injectors from a possible transition to injection, and (b) what circumstances or interventions might lead past injectors to change from injection

tion to non-injection practices. Given that non-injection drug use was associated with reduced health consequences, including a significantly lower rate of HCV infection compared with current injectors (and that past injectors would be less likely to spread HCV by way of sharing injection equipment), the potential risk reduction benefits of these circumstances are evident. As suggested, not switching to injecting or changing from injecting to other routes of administration appears to be related to a multitude of different factors, including drug availability, economics, health risk perceptions, social pressures and education, yet only a few studies have explored the possibility of such targeted interventions [62–65].

Our study has some limitations. Given that illicit opioid and other drug users are hidden populations, representative sampling is not possible [66]. In addition, recruitment for the OPICAN study did not include criteria related to injection status or behavior but focused on specific drug use patterns (i.e., frequency of opioid use). Given the suggested associations between drug use frequency and injection status, our recruitment criteria may have artificially assembled a study population with an inherent bias in terms of participants' injection status. Hence overall, our results clearly do not allow for generalizations to other drug use populations but should be viewed specifically for this population. Our analysis of injection status was based on two questions (see above), focusing on in-

jection in the 'last 30 days' and 'ever'. These questions did not allow for more sensitive analyses of detailed injection/non-injection patterns, the length of injection histories or the timing of transition from injection to non-injection that may have been desirable for more in-depth analyses. Our study also relied predominantly on self-report data, although the validity of such data from illicit drug users has been documented to be reliable and of high quality [67, 68]. Finally, given that we have used a cross-sectional study design, we are not able to investigate dynamics of causality.

Clearly, non-injection drug use and its associated characteristics are part of illicit opioid and other drug use populations in Canadian cities. Given the specific risks and harms associated with active injection and the potential lessons that can be learned from non-injectors, a more systematic examination is warranted.

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References

- 1 European Monitoring Centre for Drugs and Drug Addiction: European report on drug consumption rooms. Luxembourg, Office for Official Publications of the European Communities, 2004.
- 2 Woolf CJ, Hashmi M: Use and abuse of opioid analgesics: Potential methods to prevent and deter non-medical consumption of prescription opioids. *Curr Opin Investig Drugs* 2004; 5:61–66.
- 3 Cowan DT, Allan LG, Libretto SE, Griffiths P: Opioid drugs: a comparative survey of therapeutic and 'street' use. *Pain Med* 2001;2:193–203.
- 4 Grund J-P: From the straw to the needle? Determinants of heroin administration routes; in Inciardi J, Harrison L (eds): *Heroin in the Age of Crack-Cocaine*. London, Sage, 1998, pp 215–258.
- 5 Strang J, Griffiths P, Powis B, Gossop M: First use of heroin: changes in the route of administration over time. *BMJ* 1992;304:1222–1223.
- 6 Smyth B, O'Brien M, Barry J: Trends in treated opiate misuse in Dublin: the emergence of chasing the dragon. *Addiction* 2000;95:1217–1223.
- 7 Chitwood DD, Comerford M, Sanchez J: Prevalence and risk factors for HIV among sniffers, short-term injectors, and long-term injectors of heroin. *J Psychoactive Drugs* 2003;35:445–453.
- 8 de la Fuente L, Barrio G, Royuela L, Bravo MJ: The transition from injecting to smoking heroin in three Spanish cities. The Spanish Group for the Study of the Route of Heroin Administration. *Addiction* 1997;92:1749–1763.
- 9 van Ameijden E, Coutinho R: Large decline in injecting drug use in Amsterdam, 1986–1998: explanatory mechanisms and determinants of injecting transitions. *J Epidemiol Community Health* 2001;55:356–363.
- 10 Sotharan JL, Goldsmith DS, Blasco M, Friedman SR: Heroin sniffing as self-regulation among injecting and non-injecting heroin users. *J Drug Issues* 1999;29:401–422.
- 11 Neaigus A, Miller M, Friedman S, et al: Potential risk factors for the transition to injection among non-injecting heroin users: a comparison of former injectors and never injectors. *Addiction* 2001;96:847–860.
- 12 Griffiths P, Gossop M, Powis B, Strang J: Transitions in patterns of heroin administration: a study of heroin chasers and heroin injectors. *Addiction* 1994;89:301–309.
- 13 Fischer B, Rehm J, Brissette S, et al: Illicit opioid use in Canada: comparing social, health and drug use characteristics of untreated users in five cities (OPICAN study). *J Urban Health* 2005;82:250–266.
- 14 Strang J, Griffiths P, Powis B, Gossop M: Heroin chasers and heroin injectors: differences observed in a community sample in London, UK. *Am J Addict* 1999;8:148–160.
- 15 Stohler R, Dursteler-MacFarland K, Grameschacher C, Petitjean S, Battegay R, Ladewig D: A comparison of heroin chasers with heroin injectors in Switzerland. *Eur Addict Res* 2000; 6:154–159.

- 16 Quaglio G, Lugoboni F, Pajusco B, et al: Factors associated with hepatitis C virus infection in injection and non-injection drug users in Italy. *Clin Infect Dis* 2003;37:33–40.
- 17 Bravo MJ, Barrio G, de la Fuente L, Royuela L, Domingo L, Silva T: Reasons for selecting an initial route of heroin administration and for subsequent transitions during a severe HIV epidemic. *Addiction* 2003;98:749–760.
- 18 Strang J, Griffiths P, Powis B, Abbey J, Gossop M: How constant is an individual's route of heroin administration? Data from treatment and non-treatment samples. *Drug Alcohol Depend* 1997;46:115–118.
- 19 Swift W, Maher L, Sunjic S: Transitions between routes of heroin administration: a study of Caucasian and Indochinese heroin users in south-western Sydney, Australia. *Addiction* 1999;94:71–82.
- 20 Strang J, Griffiths P, Gossop M: Heroin smoking by 'chasing the dragon': origins and history. *Addiction* 1997;92:673–683.
- 21 Gossop M, Marsden J, Stewart D: Treatment outcomes of stimulant misusers: one year follow-up results from the National Treatment Outcome Research Study (NTORS). *Addict Behav* 2000;25:509–522.
- 22 de la Fuente L, Saavedra P, Barrio G, Royuela L, Vicente J: Temporal and geographic variations in the characteristics of heroin seized in Spain and their relation with the route of administration. Spanish Group for the Study of the Purity of Seized Drugs. *Drug Alcohol Depend* 1996;40:185–194.
- 23 Andersen HS, Sestoft D, Lillebaek T, Gabrielsen G, Hemmingsen R: Heroin dependence: consequences and precursors related to route of administration. *Nord J Psychiatry* 1999;53:153–158.
- 24 McCoy CB, Metsch LR, Chitwood DD, Miles C: Drug use and barriers to use of health care services. *Subst Use Misuse* 2001;36:789–806.
- 25 Gossop M, Darke S, Griffiths P, et al: The severity of dependence scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction* 1995;90:607–614.
- 26 Smolka M, Schmidt LG: The influence of heroin dose and route of administration on the severity of the opiate withdrawal syndrome. *Addiction* 1999;94:1191–1198.
- 27 Gossop M, Griffiths P, Powis B, Strang J: Severity of dependence and route of administration of heroin, cocaine and amphetamines. *Br J Addict* 1992;87:1527–1536.
- 28 Latkin C, Knowlton A, Sherman S: Routes of drug administration, differential affiliation, and lifestyle stability among cocaine and opiate users: implications to HIV prevention. *J Subst Abuse* 2001;13:89–102.
- 29 Barrio G, De la Fuente L, Royuela L, Diaz A, Rodriguez-Artalejo F: Cocaine use among heroin users in Spain: the diffusion of crack and cocaine smoking. Spanish Group for the Study on the Route of Administration of Drugs. *J Epidemiol Community Health* 1998;52:172–180.
- 30 Dinwiddie SH, Cottler L, Compton W, Abdallah AB: Psychopathology and HIV risk behaviors among injection drug users in and out of treatment. *Drug Alcohol Depend* 1996;43:1–11.
- 31 Razak MH, Jittiwutikarn J, Suriyanon V, et al: HIV prevalence and risks among injection and noninjection drug users in northern Thailand: need for comprehensive HIV prevention programs. *J Acquir Immune Defic Syndr* 2003;33:259–266.
- 32 Gyarmathy V, Neaigus A, Miller M, Friedman S, Des Jarlais D: Risk correlates of prevalent HIV, hepatitis B virus, and hepatitis C virus infections among non-injecting heroin users. *J Acquir Immune Defic Syndr* 2002;30:448–456.
- 33 Koblin BA, Factor SH, Wu Y, Vlahov D: Hepatitis C virus infection among non-injecting drug users in New York City. *J Med Virol* 2003;70:387–390.
- 34 Fischer B, Remis R, Haydon E: Hepatitis C, illegale Drogen und marginalisierte Populationen in Kanada: Ein kurzer Überblick zu Epidemiologie, Prävention und Behandlung; in Stover H (ed): Tagungsband zum 1. Internationalen Fachtag zu Hepatitis C. Berlin, Akzept e.V., 2004, pp 131–144.
- 35 Tortu S, McMahon J, Pouget E, Hamid R: Sharing of noninjection drug-use implements as a risk factor for Hepatitis C. *Subst Use Misuse* 2004;39:211–224.
- 36 Health Canada: Reducing the harm associated with injecting drug use in Canada. Ottawa, Federal/Provincial/Territorial Committee on Injection Drug Use, 2001.
- 37 Remis R, Leclerc P, Routledge R, et al: Consortium to characterize injection drug users in Canada (Montreal, Toronto and Vancouver) Final Report. Toronto, self-published, 1998.
- 38 Fischer B, Vasdev S, Haydon E, Baliunas D, Rehm J: Willingness for hepatitis C treatment in a sample of injection drug users in Toronto, Canada (in French). *Presse Med* 2005;34:1209–1212.
- 39 Monga N, Rehm J, Fischer B, et al: Using latent class analysis (LCA) to analyze patterns of drug use in a population of illicit opioid users. 2006, under review.
- 40 Kennedy J: Analyzing qualitative data: introductory log-linear analysis for behavioral research. New York, Praeger, 1983.
- 41 Strang J, Gossop M: Heroin prescribing in the British system: historical review. *Eur Addict Res* 1996;2:185–193.
- 42 Tyndall MW, Bruneau J, Brogly S, Spittal P: Satellite needle distribution among injection drug users: policy and practice in two Canadian cities. *J Acquir Immune Defic Syndr* 2002;31:98–105.
- 43 Spittal PM, Bruneau J, Craib KJ, et al: Surviving the sex trade: a comparison of HIV risk behaviours among street-involved women in two Canadian cities who inject drugs. *Aids Care* 2003;15:187–195.
- 44 Morissette C, Roy E, Parent R, Alary M, and the SurvUDI Group: Temporal trends in HIV incidence and risk behaviours among IDUs in the SurvUDI study 1995–2002 (abstract). *Can J Infect Dis* 2004;15(suppl A):49A.
- 45 Health Canada: I-Track: enhanced surveillance of risk behaviours among injecting drug users in Canada (pilot survey report). Ottawa, Surveillance and Risk Assessment Division, Centre for Infectious Disease Prevention and Control, Population and Public Health Branch, 2004.
- 46 Galea S, Vlahov D: Social determinants and the health of drug users: Socioeconomic status, homelessness, and incarceration. *Public Health Rep* 2002;117(suppl 1):S135–S145.
- 47 Palepu A, Strathdee SA, Hogg RS, et al: The social determinants of emergency department and hospital use by injection drug users in Canada. *J Urban Health* 1999;76:409–418.
- 48 O'Driscoll P, McGough J, Hagan H, Thiede H, Critchlow C, Alexander E: Predictors of accidental fatal drug overdose among a cohort of injection drug users. *Am J Public Health* 2001;91:984–987.
- 49 Fischer B, Brissette S, Brochu S, et al: Prevalence and determinants of overdose incidents among illicit opioid users in five cities across Canada. *Can Med Assoc J* 2004;171:235–239.
- 50 Sibthorpe B, Lear B: Circumstances surrounding needle use transitions among injection drug users: implications for HIV intervention. *Int J Addict* 1994;29:1245–1257.
- 51 Galai N, Safaeian M, Vlahov D, Bolotin A, Celentano DD: Longitudinal patterns of drug injection behavior in the ALIVE Study Cohort, 1988–2000: description and determinants. *Am J Epidemiol* 2003;158:695–704.
- 52 Crofts N, Louie R, Rosenthal D, Jolley D: The first fit: circumstances surrounding initiation into injecting. *Addiction* 1996;91:1187–1196.
- 53 Vlahov D, Junge B: The role of needle exchange programs in HIV prevention. *Public Health Rep* 1998;113(suppl 1):75–80.
- 54 Hankins C: Syringe exchange in Canada: good but not enough to stem the HIV tide. *Subst Use Misuse* 1998;33:1129–1145.
- 55 Strathdee SA, Patrick DM, Currie SL, et al: Needle exchange is not enough: lessons from the Vancouver injecting drug use study. *AIDS* 1997;11:F59–F65.
- 56 Fischer B, Rehm J, Blitz-Miller T: Injection drug use and preventive measures: a comparison of Canadian and Western European jurisdictions over time. *Can Med Assoc J* 2000;162:1709–1713.
- 57 Rehm J, Fischer B, Haydon E: Reducing the risks, harms and costs of HIV/AIDS and injection drug use: a synthesis of the evidence base for development of policies and programs. Warsaw, Health Canada/UNAIDS/Canadian International Development Agency, 2003.
- 58 Kerr T, Wood E, Small D, Palepu A, Tyndall M: Potential use of safer injection facilities among injection drug users in Vancouver's downtown eastside. *Can Med Assoc J* 2003;169:759–763.

- 59 Best D, Harris J, Gossop M, et al: Use of non-prescribed methadone and other illicit drugs during methadone maintenance treatment. *Drug Alcohol Rev* 2000;19:9–16.
- 60 Magura S, Kang S-Y, Nwakeze P, Demsky S: Temporal patterns of heroin and cocaine use among methadone patients. *Subst Use Misuse* 1998;33:2441–2467.
- 61 Fischer B, Rehm J, Kim G, Kirst M: Eyes wide shut? A conceptual and empirical critique of methadone maintenance treatment. *Eur Addict Res* 2005;11:1–12.
- 62 Hunt N, Griffiths P, Southwell M, Stillwell G, Strang J: Preventing and curtailing injecting drug use: a review of opportunities for developing and delivering 'route transition interventions'. *Drug Alcohol Rev* 1999;18:441–451.
- 63 Casriel C, Des Jarlais DC, Rodriguez R, Friedman SR, Stephenson B, Khuri E: Working with heroin sniffers: clinical issues in preventing drug injection. *J Subst Abuse Treat* 1990;7:1–10.
- 64 Hunt N, Stillwell G, Taylor C, Griffiths P: Evaluation of a brief intervention to prevent initiation into injecting drugs. *Drugs Educ, Prev Policy* 1998;5:185–194.
- 65 Des Jarlais D, Casriel C, Friedman S, Rosenblum A: AIDS and the transition to illicit drug injection – results of a randomized trial prevention program. *Br J Addict* 1992;87:493–498.
- 66 Eland-Goossensen MA, Van de Goor LAM, Vollemans EC, Hendriks VM, Garretsen HFL: Snowball sampling applied to opiate addicts outside the treatment system. *Addict Res* 1997;5:317–330.
- 67 Harrison L: The validity of self-reported data on drug use. *J Drug Issues* 1995;25:91–111.
- 68 Anglin MD, Hser YI, Chou C: Reliability and validity of retrospective behavioral self-report by narcotics addicts. *Eval Rev* 1993;17:91–108.

Announcement

The European Working Group on Treatment of Alcohol Dependence (EWGTAD) will be meeting in Warsaw on October 16–17, 2006. Themes of debate include: treatment of psychiatric co-morbidity, social environment involvement, research on physical co-morbidity.

Registration is free. A limited number of new participants is welcome. For more details contact: Secretariat EWGTAD, Ms Sabine Bruyere, bruyere@api.or.at.